

JOE Reed PTO 14 DEC 2001

Customized FORM PTO-1390		U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTORNEY DOCKET NO P07423US00/RFH
<b>TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371</b>			U.S. APPLICATION NO. 10/020659
INTERNATIONAL APPLICATION NO. PCT/AU00/00659	INTERNATIONAL FILING DATE 14 JUNE 2000	PRIORITY DATE CLAIMED 15 JUNE 1999	
TITLE OF INVENTION: A NON-RETURN VALVE			
APPLICANT(S) FOR DO/EO/US: HORTON, David			
Applicant herewith submits to the US Designated/Elected Office (DO/EO/US) the following items and other information			
<input checked="" type="checkbox"/> 1. This is a <b>FIRST</b> submission of items concerning a filing under 35 U.S.C. 371. <input type="checkbox"/> 2. This is a <b>SECOND</b> or <b>SUBSEQUENT</b> submission of items concerning a filing under 35 USC 371 <input checked="" type="checkbox"/> 3. This express request to begin national examination procedures (35 USC 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 USC 371(b) and PCT Art 22 and 39(1) <input checked="" type="checkbox"/> 4. A proper Demand for International Preliminary Examination was made by the 19 <sup>th</sup> month from the earliest claimed priority date. <input checked="" type="checkbox"/> 5. A copy of the International Application as filed (35 U.S.C. 371 (c)(2)) <input type="checkbox"/> a. is transmitted herewith (required only if not transmitted by the International Bureau) <input checked="" type="checkbox"/> b. has been transmitted by the International Bureau. <input type="checkbox"/> c. is not required, as the application was filed in the United States Receiving Office (RO/US) <input type="checkbox"/> 6. A translation of the International Application into English (35 U.S.C. 371(c)(2)). <input checked="" type="checkbox"/> 7. Amendments to the claims of the International Appln. under PCT Article 19 (35 USC 371 (c)(3)) <input type="checkbox"/> a. are transmitted herewith (required only if not transmitted by the International Bureau). <input type="checkbox"/> b. have been transmitted by the International Bureau. <input type="checkbox"/> c. have not been made; however, the time limit for making such amendments had NOT expired. <input checked="" type="checkbox"/> d. have not been made and will not be made. <input type="checkbox"/> 8. A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)). <input type="checkbox"/> 9. An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)). <input type="checkbox"/> 10. A translation of the annexes to the Int'l Prelim. Exam. Report under PCT Article 36 (35 U.S.C. 371(c)(5)) <b>Items 11. to 20. below concern document(s) or information included:</b> <input type="checkbox"/> 11. An <b>Information Disclosure Statement</b> under 37 C.F.R. 1.97 and 1.98. <input type="checkbox"/> 12. An <b>Assignment</b> document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included <input checked="" type="checkbox"/> 13. A <b>First preliminary amendment</b> . <input type="checkbox"/> 14. A <b>Second or Subsequent preliminary amendment</b> . <input type="checkbox"/> 15. A <b>substitute specification</b> . <input type="checkbox"/> 16. A <b>change of power of attorney and/or address letter</b> . <input type="checkbox"/> 17. A <b>computer-readable form of the sequence listing</b> in accordance with PCT Rule 13ter.2 & 35 USC 1.821-825. <input type="checkbox"/> 18. A <b>second copy of the published international application</b> under 35 USC 154(d)(4). <input type="checkbox"/> 19. A <b>second copy of the English translation of the international application</b> under 35 USC 154(d)(4) <input type="checkbox"/> 20. <b>Other items or information:</b> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> A copy of the Notification of Missing Requirements under 35 U.S.C. 371. <input type="checkbox"/> In the event that a petition for extension of time is required to be submitted herewith, and in the event that a separate petition does not accompany this response, applicant hereby petitions under 37 CFR 1.136(a) for an extension of time of as many months as are required to render this submission timely. Any fee is authorized in 17(c)			
Date: 14 December 2001			

LARSON & TAYLOR, PLC • 1199 North Fairfax St. • Suite 900 • Alexandria, VA 22314

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10/018056  
JC05 Rec'd PCT/PTO 14 DEC 2007  
IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Patent

In re patent application of: HORTON

Serial No.: NEW APPLICATION

Filed: On even date herewith

For: A NON-RETURN VALVE

Examiner:

Art Unit:

Dckt No.: P07423US00/RFH

**PRELIMINARY AMENDMENT**

Assistant Commissioner for Patents  
Washington, D.C.

S I R:

Prior to examination, please amend the above-identified application as follows.

**IN THE CLAIMS:**

A clean version of the amended claims is provided herewith in **Attachment A**. It will be noted that the amended claims have been amended relative to the previously provided version as shown by the marked up version thereof in **Attachment B** provided herewith.

**REMARKS**

By this Amendment, the claims have been rewritten to reduce the multiple dependencies.

Further and favorable action is solicited.

Respectfully submitted,

Date: 12/14/01

By: Douglas E. Jackson  
Douglas E. Jackson  
Registration No. 28518

LARSON & TAYLOR PLC - 1199 North Fairfax Street, Suite 900 - Alexandria, Virginia 22314 -

## ATTACHMENT A

### Clean Replacement/New Claims (entire set of pending claims)

*Following herewith is a clean copy of the entire set of pending claims.*

1. A non-return valve comprising:  
a valve body including a fluid passageway which defines a fluid inlet and a fluid outlet located on a low pressure and a high pressure side of the valve, respectively, the fluid passageway being adapted to allow a flow of fluid from the inlet to the outlet; and  
a valve diaphragm in the form of a conical-shaped diaphragm having a collapsible aperture located at or adjacent its apex which is orientated in a downstream flow direction and directed toward the high pressure side of the valve, said diaphragm being connected across the fluid passageway and being constructed of a resiliently flexible material wherein the diaphragm itself initiates closure of the collapsible aperture, said closure being further promoted by fluid on the high pressure side of the valve to thus prevent fluid flowing in a reverse direction toward the inlet whereas the application of pressure, exceeding atmospheric pressure and that on the high pressure side, to an inlet side of the diaphragm deflects the diaphragm to expose the aperture and allow fluid to flow through the passageway from the inlet to the outlet only.
2. A non-return valve as defined in claim 1 wherein the pressure is imposed on the inlet side of the diaphragm via a fluid nozzle.
3. A non-return valve as defined in claim 2 wherein the valve body is designed to fit to a reservoir or tank in which fluid is to be dispensed via the fluid nozzle.
4. A non-return valve including a bank or series of non-return valves of similar construction coupled to one another, each of said non-return valves comprising:

a valve body including a fluid passageway which defines a fluid inlet and a fluid outlet, the fluid passageway being adapted to allow a flow of fluid from the inlet to the outlet; and

a valve diaphragm being connected across the fluid passageway and including a collapsible aperture, the valve diaphragm being constructed of a resiliently flexible material and being configured wherein the diaphragm itself in a collapsed condition effects closure of the collapsible aperture to prevent fluid flowing in a reverse direction toward the inlet whereas pressure imposed on an inlet side of the diaphragm deflects the diaphragm to expose the aperture and allow fluid to flow through the passageway from the inlet to the outlet only.

5. A non-return valve as defined in claim 4 wherein the non-return valves are coupled together with their respective valve bodies at least partly nested within one another wherein said valves are co-axially aligned.

6. A non-return valve as defined in claim 4 wherein the non-return valves are each of the same construction and configured to abut or engage one another with their valve bodies in alignment.

7. (amended) A non-return valve as defined in claim 4 wherein the diaphragms are each in the form of a generally conical-shaped diaphragm having the collapsible aperture located at or adjacent its apex which is orientated in a downstream flow direction.

8. (amended) A non-return valve as defined in claim 1 wherein the valve membrane is formed integral with the valve body.

9. (amended) A non-return valve as defined in claim 1 wherein the valve membrane is constructed of a mouldable polymeric material.

10. (amended) A non-return valve as defined in claim 1 wherein the valve body is configured to retrofit to an existing valve stem.

11. (amended) A non-return valve as defined in claim 1 wherein the valve body is designed to be sealably inserted into a flow line.

12. A membrane being permeable in one direction only, said membrane comprising a panel or blanket of collapsible diaphragms each including a collapsible aperture and being constructed of a resiliently flexible material which is configured wherein each of the diaphragms themselves effects closure of the collapsible aperture to prevent fluid flowing in a reverse direction whereas pressure imposed on an upstream side of the membrane deflects one or more of the diaphragms to expose the corresponding aperture and allow fluid to flow across the membrane in said one direction only.

13. A membrane as defined in claim 12 wherein the membrane is multi-layered with a series of said panels or blankets formed adjacent one another.

## ATTACHMENT B

### Marked Up Replacement Claims

*Following herewith is a marked up copy of each rewritten claim together with all other pending claims.*

1. A non-return valve comprising:  
a valve body including a fluid passageway which defines a fluid inlet and a fluid outlet located on a low pressure and a high pressure side of the valve, respectively, the fluid passageway being adapted to allow a flow of fluid from the inlet to the outlet; and  
a valve diaphragm in the form of a conical-shaped diaphragm having a collapsible aperture located at or adjacent its apex which is orientated in a downstream flow direction and directed toward the high pressure side of the valve, said diaphragm being connected across the fluid passageway and being constructed of a resiliently flexible material wherein the diaphragm itself initiates closure of the collapsible aperture, said closure being further promoted by fluid on the high pressure side of the valve to thus prevent fluid flowing in a reverse direction toward the inlet whereas the application of pressure, exceeding atmospheric pressure and that on the high pressure side, to an inlet side of the diaphragm deflects the diaphragm to expose the aperture and allow fluid to flow through the passageway from the inlet to the outlet only.
2. A non-return valve as defined in claim 1 wherein the pressure is imposed on the inlet side of the diaphragm via a fluid nozzle.
3. A non-return valve as defined in claim 2 wherein the valve body is designed to fit to a reservoir or tank in which fluid is to be dispensed via the fluid nozzle.
4. A non-return valve including a bank or series of non-return valves of similar construction coupled to one another, each of said non-return valves comprising:

a valve body including a fluid passageway which defines a fluid inlet and a fluid outlet, the fluid passageway being adapted to allow a flow of fluid from the inlet to the outlet; and

a valve diaphragm being connected across the fluid passageway and including a collapsible aperture, the valve diaphragm being constructed of a resiliently flexible material and being configured wherein the diaphragm itself in a collapsed condition effects closure of the collapsible aperture to prevent fluid flowing in a reverse direction toward the inlet whereas pressure imposed on an inlet side of the diaphragm deflects the diaphragm to expose the aperture and allow fluid to flow through the passageway from the inlet to the outlet only.

5. A non-return valve as defined in claim 4 wherein the non-return valves are coupled together with their respective valve bodies at least partly nested within one another wherein said valves are co-axially aligned.

6. A non-return valve as defined in claim 4 wherein the non-return valves are each of the same construction and configured to abut or engage one another with their valve bodies in alignment.

7. (amended) A non-return valve as defined in ~~any one of claims 4 to 6~~ claim 4 wherein the diaphragms are each in the form of a generally conical-shaped diaphragm having the collapsible aperture located at or adjacent its apex which is orientated in a downstream flow direction.

8. (amended) A non-return valve as defined in ~~any one of the preceding claims~~ claim 1 wherein the valve membrane is formed integral with the valve body.

9. (amended) A non-return valve as defined in ~~any one of the preceding claims~~ claim 1 wherein the valve membrane is constructed of a mouldable polymeric material.

10. (amended) A non-return valve as defined in ~~any one of the preceding claims claim 1~~ wherein the valve body is configured to retrofit to an existing valve stem.

11. (amended) A non-return valve as defined in ~~any one of the preceding claims claim 1~~ wherein the valve body is designed to be sealably inserted into a flow line.

12. A membrane being permeable in one direction only, said membrane comprising a panel or blanket of collapsible diaphragms each including a collapsible aperture and being constructed of a resiliently flexible material which is configured wherein each of the diaphragms themselves effects closure of the collapsible aperture to prevent fluid flowing in a reverse direction whereas pressure imposed on an upstream side of the membrane deflects one or more of the diaphragms to expose the corresponding aperture and allow fluid to flow across the membrane in said one direction only.

13. A membrane as defined in claim 12 wherein the membrane is multi-layered with a series of said panels or blankets formed adjacent one another.

A NON-RETURN VALVE

## FIELD OF THE INVENTION

The present invention relates generally to a non-return  
5 valve such as that used on a pneumatic tyre, and a membrane  
being permeable in one direction only.

## BACKGROUND TO THE INVENTION

Non-return valves are common in industrial and domestic  
10 applications and are particularly prolific on pneumatic  
tyres. Figure 1 illustrates the various components of a  
conventional pneumatic non-return valve 1. The valve 1  
comprises an inlet casing 2 which is screw threaded within  
a valve stem of a tyre (not shown). The inlet casing 2  
15 houses a shaft 3 along which a valve member 4 slidably  
moves. The valve member 4 is biased against a seat 5 of  
the casing 2 under the force of a compression spring 6 so  
as to close the valve 1. A spring retainer 7 is connected  
to an end of the shaft 3 so as to retain the compression  
20 spring 6. Pressurisation of the non-return valve 1  
releases the valve member 4 from the seat 5 to allow  
filling of the tyre.

The conventional pneumatic non-return valve 1 suffers from  
25 at least the following problems:

- i) the valve 1 has a relatively large number of components which may require periodic servicing and maintenance;
- ii) the valve 1 is expensive including relatively  
30 complex machined components; and

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iii) the valve is complicated in operation and thus in operation may be susceptible to failure.

5 SUMMARY OF THE INVENTION

According to one aspect of the present invention there is provided a non-return valve comprising:

10 a valve body including a fluid passageway which defines a fluid inlet and a fluid outlet located on a low pressure and a high pressure side of the valve, respectively, the fluid passageway being adapted to allow a flow of fluid from the inlet to the outlet; and

15 a valve diaphragm in the form of a conical-shaped diaphragm having a collapsible aperture located at or adjacent its apex which is orientated in a downstream flow direction and directed toward the high pressure side of the valve, said diaphragm being connected across the fluid passageway and being constructed of a resiliently flexible  
20 material wherein the diaphragm itself initiates closure of the collapsible aperture, said closure being further promoted by fluid on the high pressure side of the valve to thus prevent fluid flowing in a reverse direction toward the inlet whereas the application of pressure, exceeding  
25 atmospheric pressure and that on the high pressure side, to an inlet side of the diaphragm deflects the diaphragm to expose the aperture and allow fluid to flow through the passageway from the inlet to the outlet only.

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Typically the pressure is imposed on the inlet side of the diaphragm via a fluid nozzle which is designed to be retractably received within the passageway.

5

Generally the fluid is a liquid such as petrol and the non-return valve serves to prevent a reverse flow or escape of vapours.

10

Preferably the valve body is designed to fit to a reservoir or tank in which fluid is to be dispensed via the fluid nozzle. For example, the non-return valve is configured to fit to a petrol tank.

15

According to a further aspect of the present invention there is provided a non-return valve including a bank or series of non-return valves of similar construction coupled to one another, each of said non-return valves comprising:

20 a valve body including a fluid passageway which defines a fluid inlet and a fluid outlet, the fluid passageway being adapted to allow a flow of fluid from the inlet to the outlet; and

25 a valve diaphragm being connected across the fluid passageway and including a collapsible aperture, the valve diaphragm being constructed of a resiliently flexible material and being configured wherein the diaphragm itself in a collapsed condition effects closure of the collapsible  
30 aperture to prevent fluid flowing in a reverse direction toward the inlet whereas pressure imposed on an inlet side of the diaphragm deflects the diaphragm to expose the

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aperture and allow fluid to flow through the passageway from the inlet to the outlet only.

- 5 Generally the non-return valves are coupled together with their respective valve bodies at least partly nested within one another wherein said valves are co-axially aligned. Alternatively the non-return valves are each of the same construction and configured to abut or engage one another  
10 with their valve bodies in alignment.

- Preferably each of the diaphragms is formed integral with the corresponding valve body. More preferably the  
15 diaphragms are each in the form of a generally conical-shaped diaphragm having the collapsible aperture located at or adjacent its apex which is orientated in a downstream flow direction.

- 20 Generally said actuating means is a fluid nozzle which is retractably inserted into at least one of the collapsible apertures to permit a flow of fluid across the corresponding diaphragm via the fluid nozzle.

- 25 Preferably the valve membrane is formed integral with the valve body.

- 30 Typically the valve membrane is constructed of a mouldable polymeric material. More typically the polymeric material is an elastomer such as a rubber material. Alternatively the polymeric material is a nylon-based material.

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Preferably the valve body is configured to retrofit to an existing valve stem. Alternatively the valve body is designed to be sealably inserted into a flow line.

5

Generally the fluid is water or compressed air.

- 10 According to yet a further aspect of the present invention there is provided a membrane being permeable in one direction only, said membrane comprising a panel or blanket of collapsible diaphragms each including a collapsible

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aperture and being constructed of a resiliently flexible material which is configured wherein each of the diaphragms themselves effects closure of the collapsible aperture to prevent fluid flowing in a reverse direction whereas  
5 pressure imposed on an upstream side of the membrane deflects one or more of the diaphragms to expose the corresponding aperture and allow fluid to flow across the membrane in said one direction only.

10 Generally the membrane is multi-layered with a series of said panels or blankets formed adjacent one another.

#### BRIEF DESCRIPTION OF THE DRAWINGS

In order to facilitate a better understanding of the nature  
15 of the present invention several embodiments of a non-return valve and a membrane being permeable in one direction only will now be described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a general assembly of a conventional  
20 pneumatic non-return valve;

Figure 2 illustrates three stages in the general assembly of a non-return valve according to one embodiment of the invention;

Figure 3 is a general assembly of another embodiment  
25 of the invention suitable for use with irrigation tubing;

Figure 4 is a general assembly of a further embodiment of a non-return valve of the invention suitable for use in pneumatic tyres;

Figure 5 is an assembly of a non-return valve of yet  
30 another embodiment of the invention suitable for tubeless pneumatic tyres;

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Figure 6 is a general assembly of a non-return valve of another aspect of the invention;

Figure 7 is an elevational and part cutaway view of a tool suitable for moulding of the non-return valve;

5        Figure 8 is a part cutaway together with an enlarged view of the tool of Figure 7;

Figure 9 is sectional views of the tool of Figures 7 and 8;

10       Figure 10 illustrates three embodiments of a non-return valve according to a further aspect of the invention;

Figures 11A to 11C depict another embodiment of this aspect of a non-return valve incorporated in a quick connect coupling of a hydraulic line;

15       Figure 12 is an exploded sectional view of various components of the non-return valve of Figures 11A to 11C; and

20       Figure 13 is a sectional representation of a membrane according to yet another aspect of the invention being permeable in one direction only.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

As shown in Figures 2 to 5 there are various embodiments of a non-return valve shown generally as 10 constructed in accordance with one aspect of the invention. For ease of reference and in order to avoid repetition like components have been designated with the same reference numerals.

30       In each example the non-return valve 10 comprises a valve body 12 and a valve membrane 14. The valve body 12 is generally tubular and includes an elongate passageway 16 having an inlet and an outlet defined at its opposing ends 18 and 20, respectively.

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The non-return valve 10 of these embodiments is moulded from a polymeric material, preferably an elastomer such as rubber or a nylon-based material. The selection of the appropriate material for the valve 10 will be obvious to one skilled in the art without trial and experimentation. The valve membrane 14 is in the form of a conical-shaped diaphragm formed integral with the tubular valve body 12. The diaphragm 14 is configured as a generally conical-shaped element having a collapsible opening or aperture 22 located at or adjacent its apex. The conical diaphragm 14 is orientated with its apex in a downstream flow direction. The resiliently flexible material from which the diaphragm 14 is constructed ensures that the diaphragm 14 in a collapsed condition obstructs or closes the aperture 22 to prevent fluid flowing in a reverse direction toward the inlet 18. On the other hand, pressurisation of fluid within the passageway 16 on the inlet side of the diaphragm 14 deflects the diaphragm 14 to expose the aperture 22. Thus, with the aperture 22 exposed fluid is allowed to flow through the passageway 16 from the inlet 18 to the outlet 20 only.

Figures 2 to 5 depict installation of variations on the non-return valve 10 in various applications. The non-return valve 10 of Figure 2 is flared at its inlet 18 and is configured to seat within an internally and externally threaded nipple 24. An externally threaded conduit 26 and an internally threaded conduit 28 then threadably engage the respective male/female threaded nipple 24 so as to form a mated union shown generally as 30. The mated union 30 is designed so that sufficient compression is applied to the valve body 12 to seal it within the nipple 24. It will be appreciated that the non-return valve 10 can be adapted to suit any standard and pre-existing plumbing components such as the threaded nipple 24 and conduits 26 and 28 described.

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Figure 3 shows another non-return valve 10 which in this embodiment is suitable as a "slip on union" such as that used with adjacent lengths of irrigation tubing such as 32 and 34. In this example the tubing 32 and 34 is expanded over respective ends of the tubular valve body 12. As indicated in enlarged detail one or more barbs such as 36 may be included in the valve body 12 to both provide firm engagement with and enhance the seal between the tube 32 and 34 and the valve body 12. Fitting of the polyethylene tube 32 or 34 to the valve 10 may involve heating of the tubing to improve its pliability. The tubing 32 or 34 will naturally cool under ambient conditions after it has been slipped over the valve body 12.

Figure 4 shows another variant of the non-return valve 10 which may be substituted for the conventional pneumatic non-return valve 1. In this embodiment the valve body 12 is provided with an external thread 38 for securing the valve 10 within a stem 40. The stem 40 is preferably that of the conventional pneumatic non-return valve 1.

Figure 5 shows installation of the non-return valve 10 of Figure 4 in a pneumatic tyre of a tubeless configuration. The valve stem 40 is located in a conventionally fabricated rubber casing 42 which includes an annular channel 44 in which a wheel rim is seated. Alternatively, the rubber casing may be formed integral with the non-return valve 10. In this example the height of the rubber casing 42 or valve body 12 is reduced so that it is stiffened for insertion into the wheel rim. Furthermore, an inner lip 46 of the casing or valve body 12 is reduced in sectional size and profile so as to assist in seating of the channel 44 about the rim.

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Figure 6 illustrates one example of a non-return valve 50 according to another aspect of the invention. The non-return valve 50 is similar in construction to those described above with a tubular valve body 52 and a conical-shaped diaphragm 54. The tubular body 52 includes a passageway 56 defining an inlet and outlet 58 and 60 either side of the diaphragm 54. The diaphragm 54 is formed integral with the valve body 52 and fabricated or moulded from resiliently flexible polymeric materials.

In this particular construction of the non-return valve 50 an annular flange 62 is provided at the inlet end of the valve body 52. The valve body 52 fits about a filler tube 64 of a fuel tank and the flange 62 provides a seal against a panel 66 of a motor vehicle (not shown). In use, a filler nozzle 68 is retractably received within the valve 10 so as to deflect the diaphragm 54 to permit a flow of gasoline into the fuel tank via the nozzle 68. Thus, the diaphragm 54 is resiliently deformed so as to expose a collapsible opening 70 through which the nozzle 68 passes. Importantly, the diaphragm 54 forms about the nozzle 68 to prevent the escape of gasoline vapours from the filler tube 64 or tank. When the nozzle is retracted from the valve 50 the valve membrane 54 returns to its collapsed condition wherein it obstructs or closes the collapsible opening 70. Thus, in the collapsed condition fuel vapour is prevented from escaping the tank or flowing in a reversed direction toward the inlet 58.

Figures 7 to 9 schematically illustrate a moulding tool which is appropriate for forming a non-return valve such as 10 described above. The tool shown generally as 80 is designed for use in a conventional injection moulding machine.

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The tool 80 includes two (2) mutually engagable die sections 82 and 84. Each of the die sections 82 and 84 includes a shaft and a collar 86/88 and 90/92, respectively. The shaft 86 and collar 88 of one of the die sections 82 is machined together whereas the collar 92 is allowed to rotate on the shaft 90 of the other die section 84. This allows for removal of the tool 80 from the external thread 38 of the non-return valve 10 of this example. The part cut-away view of Figure 7 shows in some detail the internal geometry of the tool 80 which defines an internal cavity 94 for injection of the polymeric material. Importantly, a relatively thin projection 96 is connected to the shaft 86 and extends across the apex of the resultant valve 10. This projection 96 thus forms or defines the collapsible opening or aperture 22 of the valve 10.

Figure 8 illustrates the tool 80 of Figure 7 in a retracted position with the die section 82 removed from the injected valve 10. The collar 92 of the other die section 84 is then rotated so as to release the injected valve 10 from the tool 80. As the injected polymer cools the membrane or diaphragm 14 is released from the shaft 90 of the other die section 84. However, the shaft 90 of the other die section 84 may also include a plunger or other means to assist or aid in removal of the injected valve 10. Figure 8 also depicts injection and relief ports 98 and 100, respectively, which provide a flow of polymer to the die cavity 90. One of the die sections 82 or 84 may also include a dowel pin 102 for interengagement of the die sections 82 and 84. The injector ports 98 provide a discriminate point for polymer to be injected uniformly throughout the cavity 90 of the tool 80. The relief ports 100 allow an even flow and distribution of injected polymer throughout the die cavity 90.

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As shown in Figure 10 there are three embodiments of a further aspect of a non-return valve 100 comprising a bank or series of non-return valves such as 120 and 140 of similar construction coupled to one another. The overall non-return valve 100 is thus of a "fail-safe" configuration. For ease of reference and in order to avoid repetition like components have been designated with the same reference numerals.

In this particular construction of the fail-safe non-return valve 100 each of the series of non-return valves such as 120 and 140 includes a valve body such as 160 or 180 together with a corresponding valve membrane such as 200 or 220. The valve bodies 160 or 180 are generally tubular and moulded together with the corresponding diaphragm 200 or 220 which is configured as a generally conical-shaped element. Importantly, the diaphragm 200 or 220 includes a collapsible aperture 240 or 260 formed at its apex. The conical diaphragm 200 or 220 is orientated with its apex in a downstream flow direction.

In this example the collapsible diaphragms 200 and 220 are moulded from a polymeric material, preferably an elastomer such as rubber or a nylon-based material. The particular shape of the diaphragm 200 or 220 together with the resilient material from which it is constructed ensures that the diaphragm 200 or 220 in a collapsed condition obstructs or closes the aperture 240 or 260 to prevent fluid flowing in an upstream direction. On the other hand, with pressure imposed on an upstream side of either of the diaphragms 200 or 220 said diaphragm is deflected to expose the corresponding collapsible aperture 240 or 260. Thus, with the collapsible apertures 240 or 260 exposed fluid is

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allowed to flow in a downstream direction through the fail-safe non-return valve 100.

Figure 10 depicts two configurations of the fail-safe non-return valve 100 where either two non-return valves such as 120 and 140 are nested within one another or are of substantially the same configurations and merely abut one another. In the "nested" embodiment of the fail-safe non-return valve 100 the outer body 160 of the outer valve 120 is internally threaded and designed to engage the inner body 180 of the inner valve 140. In the other embodiment, adjacent valve bodies 160 and 180 are aligned with one another and may together be housed or contained within a valve casing (not shown). In both cases the valve diaphragms such as 200 and 220 are oriented such that their respective collapsible apertures 240 and 260 are aligned and coaxial with one another. An internal bore of the valve bodies 160 and 180 together defines a fluid passageway 280 of the non-return valve 100 including a fluid inlet 300 and outlet 320.

Figures 11A to 11C illustrate another aspect of a non-return valve according to the invention which in this embodiment is designed to be incorporated in a quick connect coupling shown generally as 500 of a hydraulic line or hose 520. The hydraulic coupling 500 is designed to threadably engage a valve casing 540 in which another embodiment of a non-return valve 1000 is mounted. For ease of reference and in order to avoid repetition components of this non-return valve 1000 which are similar to the non-return valve 10 or 100 described above are designated with an additional "0". For example, the diaphragms are designated as 200 and 2200.

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In this application the valve diaphragms 200 and 220 are actuated not by fluid pressure but rather via a fluid nozzle which in this example is in the form of a fluid injector 560 which is connected to the hydraulic hose 520 via barbs 580 formed about a periphery of the injector 560. Figures 11A to 11C show the sequential steps involved in connecting the quick coupling 500 to the casing 540. The injector coupling 500 is initially slid longitudinally along the injector 560 until it abuts an annular flange 600 formed about the injector 560. The injector 560 is then pressed into engagement with the diaphragms 2000 and 2200 so as to expose their corresponding collapsible apertures 2400 and 2600. The coupling 500 is progressively threaded onto the casing 540 so as to drive the injector 560 into engagement with the diaphragms 2000 and 2200. Thus, in this example, hydraulic fluid or the like which is contained in the casing 540 and any associated plumbing is allowed to flow to the flexible hose 520 upon connection of the quick coupling 500. The nozzle 560 thus serves as the means for actuating the valve 1000 of this particular aspect of the invention.

Figure 12 illustrates an exploded sectional view of the valve 1000 incorporated in the quick connect hydraulic coupling described. Each of the valve bodies 1200 and 1400 is designed to coaxially press-fit within the casing 540. Each body 1200 and 1400 includes an annular recess 620 being shaped complementary to and designed to be engaged by a corresponding ridge 640 formed circumferentially within an inner surface of the casing 540.

Figure 13 depicts one example of a membrane 1000' of another aspect of the invention. The membrane 1000' is permeable in one direction only and on a microscopic scale may be applied as a means of repairing a lung. The

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membrane 1000' is multi-layered with a series of panels or blankets of collapsible diaphragms such as 2000' being formed alongside one another. In this embodiment each of the diaphragms such as 2000' includes a corresponding valve body 1600' which is formed integral with an adjacent valve body of an adjacent diaphragm. However, it should be appreciated that the membrane 1000' need not include this arrangement of valve bodies but rather may be limited to a panel or blanket of interconnected collapsible diaphragms. In any case the membrane 1000' functions along the same lines as the non-return valve 10 or 100 described above. That is, pressure imposed on an upstream side of the membrane 1000' deflects one or more of the diaphragms such as 2000' to expose its corresponding aperture 2400' to allow fluid to flow across the membrane 1000'. On the other hand, without a positive pressure imposed on the upstream side of the membrane 1000', the diaphragms such as 2000' are in a collapsed condition such that the collapsible apertures such as 2400' are closed to prevent the flow of fluid in a reverse direction across the membrane 1000'.

Now that several preferred embodiments of the various aspects of the present invention have been described in some detail it will be apparent to those skilled in the art that the non-return valve and permeable membrane have at least the following advantages:

- (i) the non-return valve is relatively simple in construction;
- (ii) the non-return valve is effective in operation relying on fluid pressure for opening, and valve membrane characteristics and design for closure; and
- (iii) the non-return valve is relatively inexpensive to manufacture.

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Those skilled in the art will appreciate that the invention described herein is susceptible to variations and modifications other than those specifically described. For example, injection moulding is merely one exemplary technique of forming the non-return valves. the diaphragm may be constructed of practically any resiliently flexible material which in a collapsed condition obstructs the collapsible aperture to prevent flow across the valve or membrane. The non-return valves may extend to applications other than those described above. For example, the fail-safe non-return valve may be connected across the skin of a ships hull and provide a means of quick evacuation where the human body can slip through the dual or multiple diaphragm valves.

All such variations and modifications are to be considered within the scope of the present invention the nature of which is to be determined from the foregoing description.

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CLAIMS:

1. A non-return valve comprising:

5 a valve body including a fluid passageway which defines a fluid inlet and a fluid outlet located on a low pressure and a high pressure side of the valve, respectively, the fluid passageway being adapted to allow a flow of fluid from the inlet to the outlet; and

10 a valve diaphragm in the form of a conical-shaped diaphragm having a collapsible aperture located at or adjacent its apex which is orientated in a downstream flow direction and directed toward the high pressure side of the valve, said diaphragm being connected across the fluid passageway and being constructed of a resiliently flexible  
15 material wherein the diaphragm itself initiates closure of the collapsible aperture, said closure being further promoted by fluid on the high pressure side of the valve to thus prevent fluid flowing in a reverse direction toward the inlet whereas the application of pressure, exceeding  
20 atmospheric pressure and that on the high pressure side, to an inlet side of the diaphragm deflects the diaphragm to expose the aperture and allow fluid to flow through the passageway from the inlet to the outlet only.

25 2. A non-return valve as defined in claim 1 wherein the pressure is imposed on the inlet side of the diaphragm via a fluid nozzle.

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3. A non-return valve as defined in claim 2 wherein the valve body is designed to fit to a reservoir or tank in which fluid is to be dispensed via the fluid nozzle.

5 4. A non-return valve including a bank or series of non-return valves of similar construction coupled to one another, each of said non-return valves comprising:

10 a valve body including a fluid passageway which defines a fluid inlet and a fluid outlet, the fluid passageway being adapted to allow a flow of fluid from the inlet to the outlet; and

15 a valve diaphragm being connected across the fluid passageway and including a collapsible aperture, the valve diaphragm being constructed of a resiliently flexible material and being configured wherein the diaphragm itself in a collapsed condition effects closure of the collapsible aperture to prevent fluid flowing in a reverse direction toward the inlet whereas pressure imposed on an inlet side of the diaphragm deflects the diaphragm to expose the  
20 aperture and allow fluid to flow through the passageway from the inlet to the outlet only.

25 5. A non-return valve as defined in claim 4 wherein the non-return valves are coupled together with their respective valve bodies at least partly nested within one another wherein said valves are co-axially aligned.

30 6. A non-return valve as defined in claim 4 wherein the non-return valves are each of the same construction and configured to abut or engage one another with their valve bodies in alignment.

35 7. A non-return valve as defined in any one of claims 4 to 6 wherein the diaphragms are each in the form of a generally conical-shaped diaphragm having the collapsible

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aperture located at or adjacent its apex which is orientated in a downstream flow direction.

8. A non-return valve as defined in any one of the preceding claims wherein the valve membrane is formed integral with the valve body.

9. A non-return valve as defined in any one of the preceding claims wherein the valve membrane is constructed of a mouldable polymeric material.

10. A non-return valve as defined in any one of the preceding claims wherein the valve body is configured to retrofit to an existing valve stem.

11. A non-return valve as defined in any one of the preceding claims wherein the valve body is designed to be sealably inserted into a flow line.

12. A membrane being permeable in one direction only, said membrane comprising a panel or blanket of collapsible diaphragms each including a collapsible aperture and being constructed of a resiliently flexible material which is configured wherein each of the diaphragms themselves effects closure of the collapsible aperture to prevent fluid flowing in a reverse direction whereas pressure imposed on an upstream side of the membrane deflects one or more of the diaphragms to expose the corresponding aperture and allow fluid to flow across the membrane in said one direction only.

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13. A membrane as defined in claim 12 wherein the membrane is multi-layered with a series of said panels or blankets formed adjacent one another.

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	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100	2101	2102	2103	2104	2105	2106	2107	2108	2109	2110	2111	2112	2113	2114	2115	2116	2117	2118	2119	2120	2121	2122	2123	2124	2125	2126	2127	2128	2129	2130	2131	2132	2133	2134	2135	2136	2137	2138	2139	2140	2141	2142	2143	2144	2145	2146	2147	2148	2149	2150	2151	2152	2153	2154	2155	2156	2157	2158	2159	2160	2161	2162	2163	2164	2165	2166	2167	2168	2169	2170	2171	2172	2173	2174	2175	2176	2177	2178	2179	2180	2181	2182	2183	2184	2185	2186	2187	2188	2189	2190	2191	2192	2193	2194	2195	2196	2197	2198	2199	2200	2201	2202	2203	2204	2205	2206	2207	2208	2209	2210	2211	2212	2213	2214	2215	2216	2217	2218	2219	2220	2221	2222	2223	2224	2225	2226	2227	2228	2229	2230	2231	2232	2233	2234	2235	2236	2237	2238	2239	2240	2241	2242	2243	2244	2245	2246	2247	2248	2249	2250	2251	2252	2253	2254	2255	2256	2257	2258	2259	2260	2261	2262	2263	2264	2265	2266	2267	2268	2269	2270	2271	2272	2273	2274	2275	2276	2277	2278	2279	2280	2281	2282	2283	2284	2285	2286	2287	2288	2289	2290	2291	2292	2293	2294	2295	2296	2297	2298	2299	2300	2301	2302	2303	2304	2305	2306	2307	2308	2309	2310	2311	2312	2313	2314	2315	2316	2317	2318	2319	2320	2321	2322	2323	2324	2325	2326	2327	2328	2329	2330	2331	2332	2333	2334	2335	2336	2337	2338	2339	2340	2341	2342	2343	2344	2345	2346	2347	2348	2349	2350	2351	2352	2353	2354	2355	2356	2357	2358	2359	2360	2361	2362	2363	2364	2365	2366	2367	2368	2369	2370	2371	2372	2373	2374	2375	2376	2377	2378	2379	2380	2381	2382	2383	2384	2385	2386	2387	2388	2389	2390	2391	2392	2393	2394	2395	2396	2397	2398	2399	2400	2401	2402	2403	2404	2405	2406	2407	2408	2409	2410	2411	2412	2413	2414	2415	2416	2417	2418	2419	2420	2421	2422	2
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International Bureau



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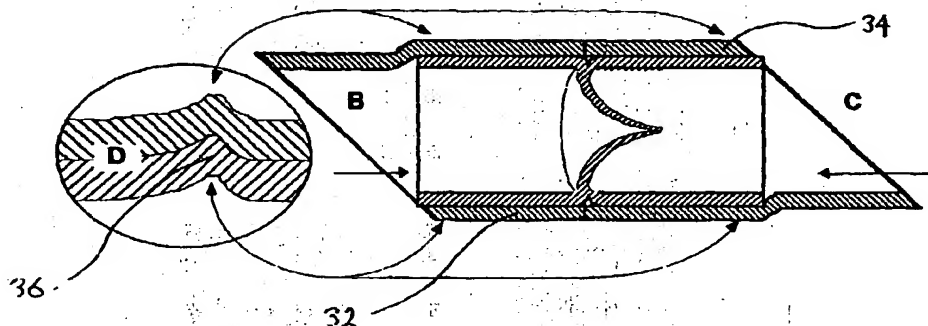
- (51) International Patent Classification<sup>7</sup>: F16K 15/14, 7/02, 7/04, 7/07, B60C 29/00, B32B 3/24 (74) Agent: GRIFFITH HACK: 168 Walker Street, North Sydney, NSW 2001 (AU).
- (21) International Application Number: PCT/AU00/00659 (81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.
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- (72) Inventor; and
- (75) Inventor/Applicant (for US only): HORTON, David [US/AU]; 35 Alexandra Street, Drummoyne, NSW 2047 (AU).
- (84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:

— With international search report.

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: A NON-RETURN VALVE



(57) Abstract: A non-return valve (10), typically of commonly called duckhill valve shape, comprising a valve body (12) and a valve membrane (14). The valve body (12) is generally tubular and includes an elongate passageway (16) with inlet (18) and outlet (20) at opposing ends. The valve membrane (14) is of a generally conical-shaped diaphragm formed integrally with the valve body (12). The diaphragm (14) has a collapsible opening or aperture (22) located at or adjacent the cone's apex. The conical diaphragm (14) is oriented with its apex pointing downstream. The resiliently flexible material from which the diaphragm (14) is constructed, ensures that the diaphragm (14) in a collapsed condition obstructs or closes the aperture (22) to prevent fluid flowing in a reverse direction, i.e. backflow towards the inlet. Pressurisation of fluid within the passageway (16) on the inlet (18) side of the diaphragm (14), deflects the diaphragm to open the aperture (22) so that fluid can flow through the passageway from the inlet (18) to the outlet (20) only. A membrane permeable in one direction only can also be made from a panel or sheeting incorporating many such collapsible non-return duckbill valves on the surface of the panel or sheet.

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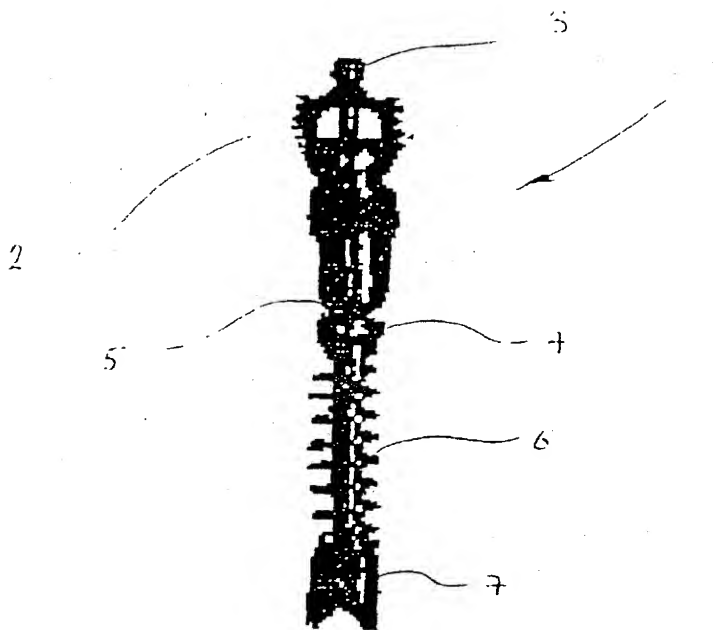


FIG. 1

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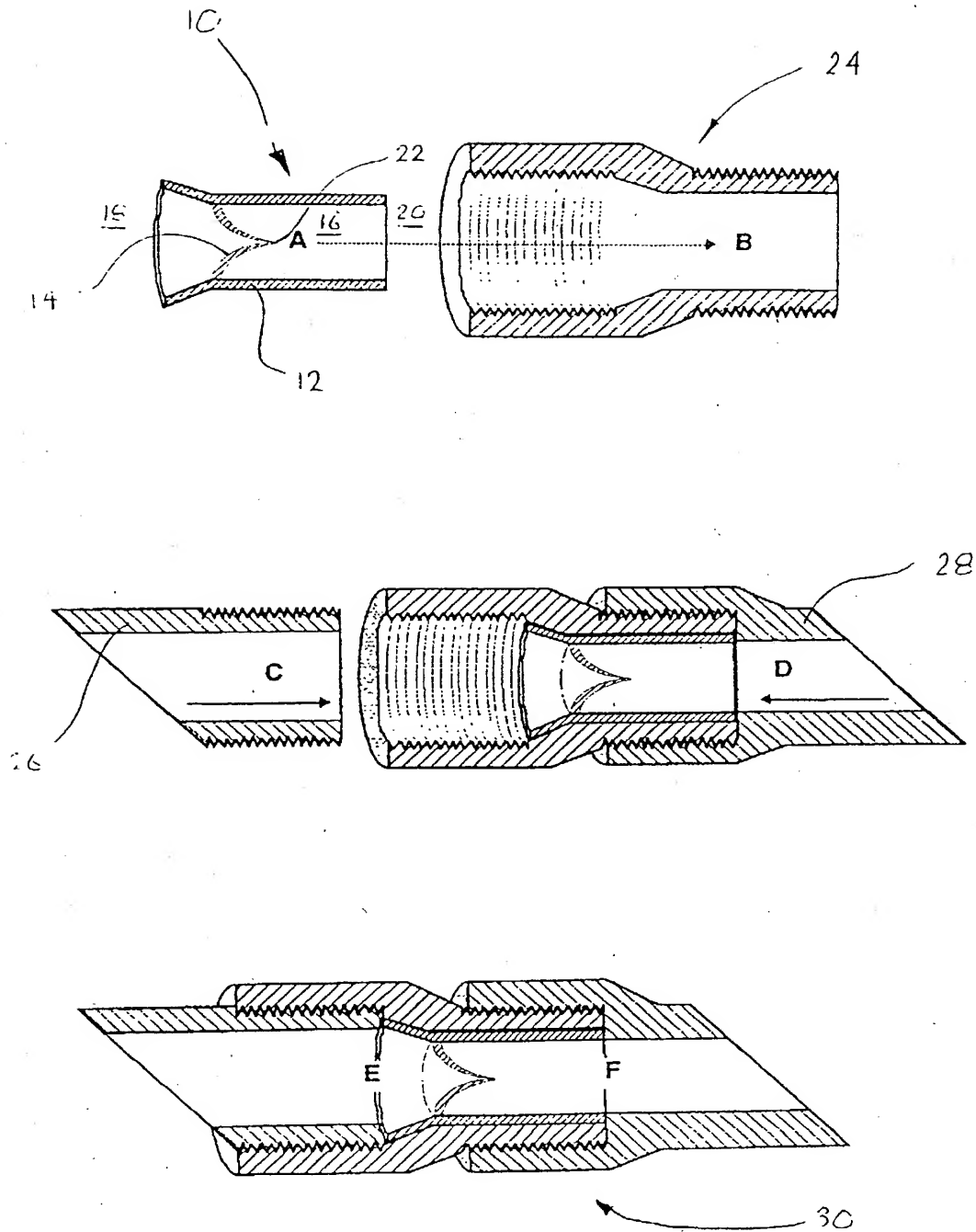


FIG. 2

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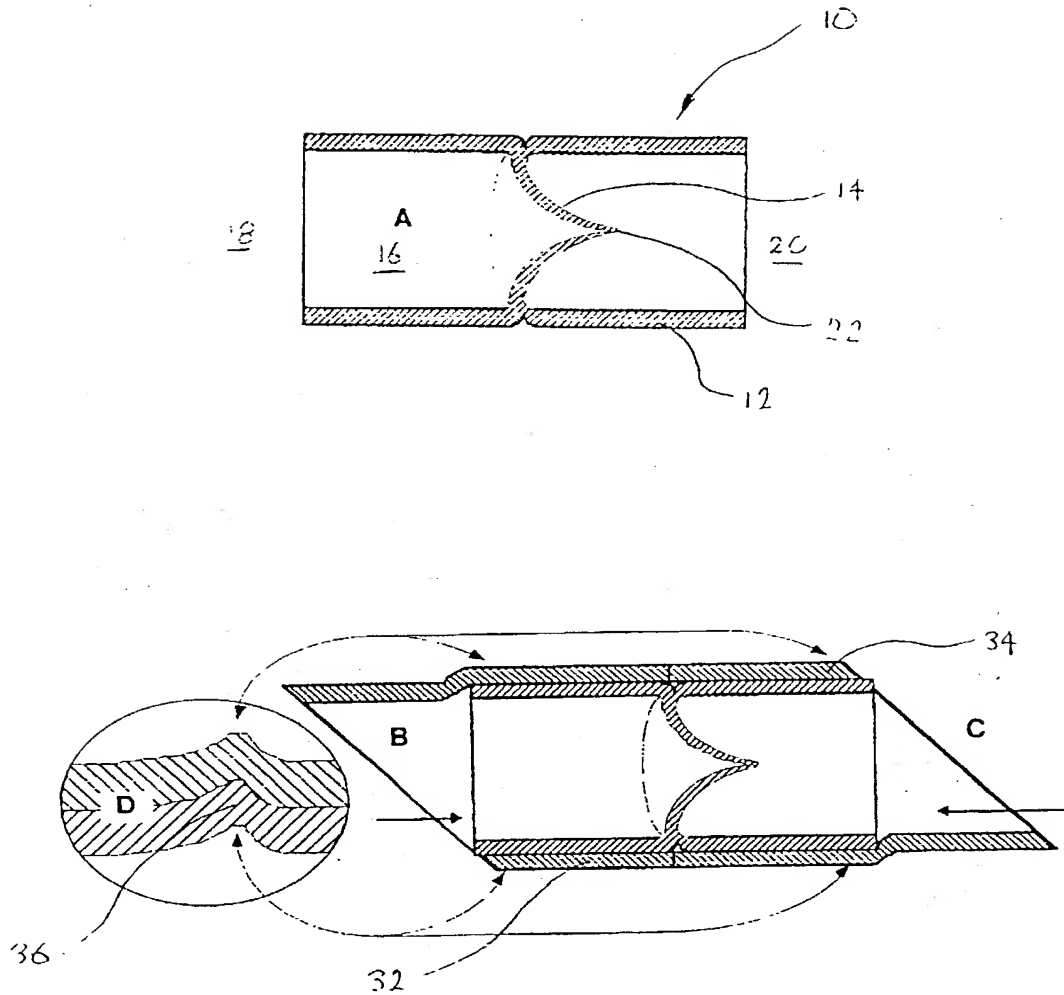


FIG. 3

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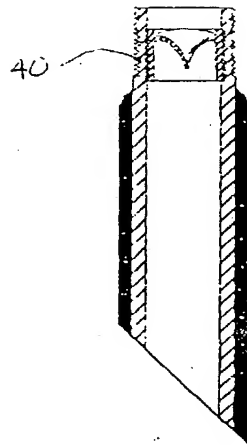
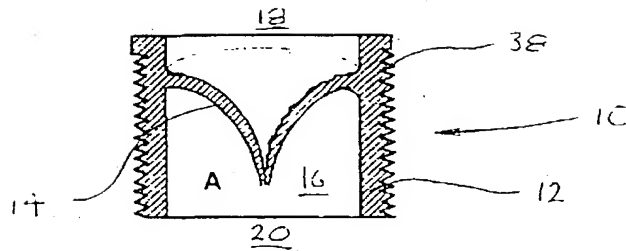


FIG. 4

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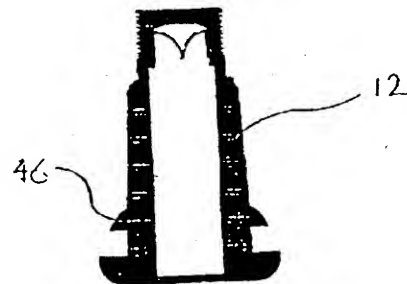
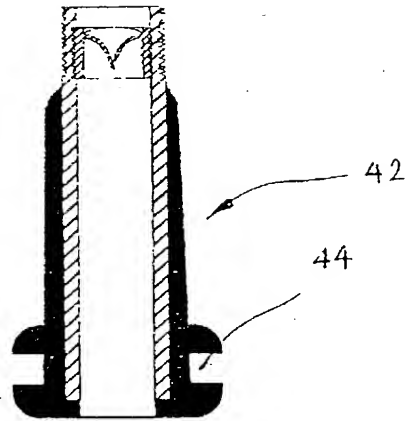


FIG. 5

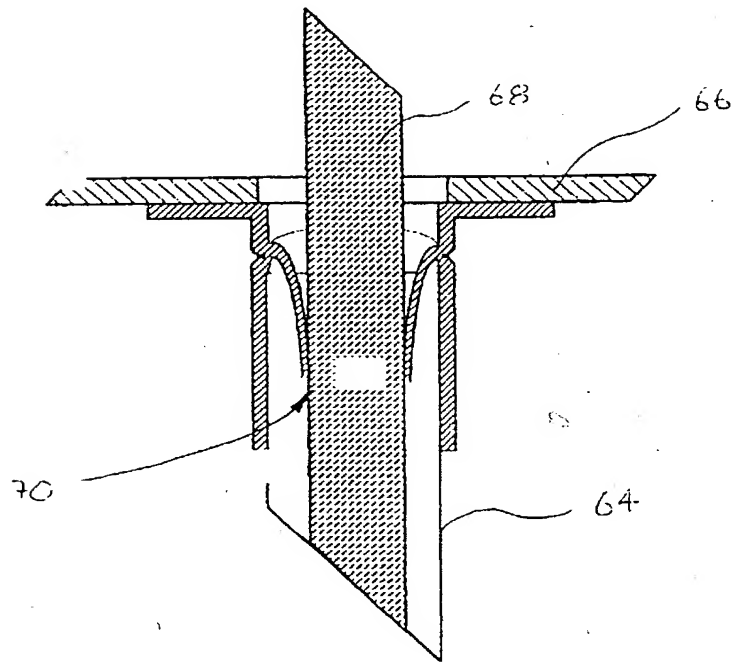
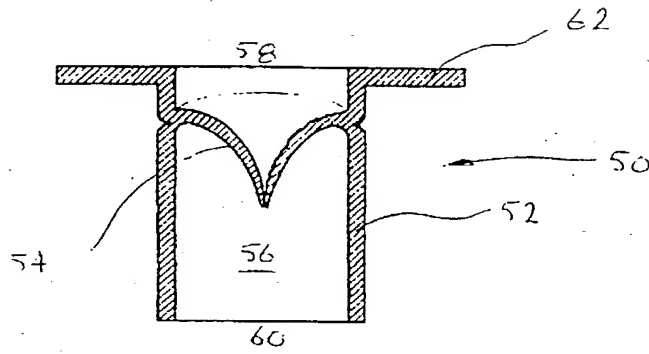


FIG. 6

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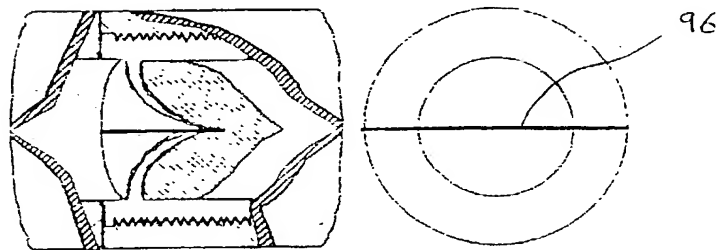
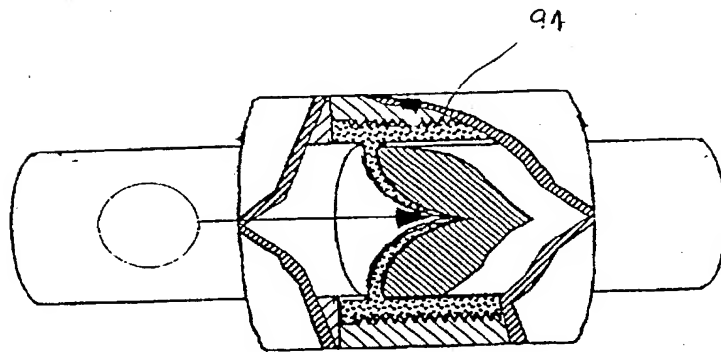
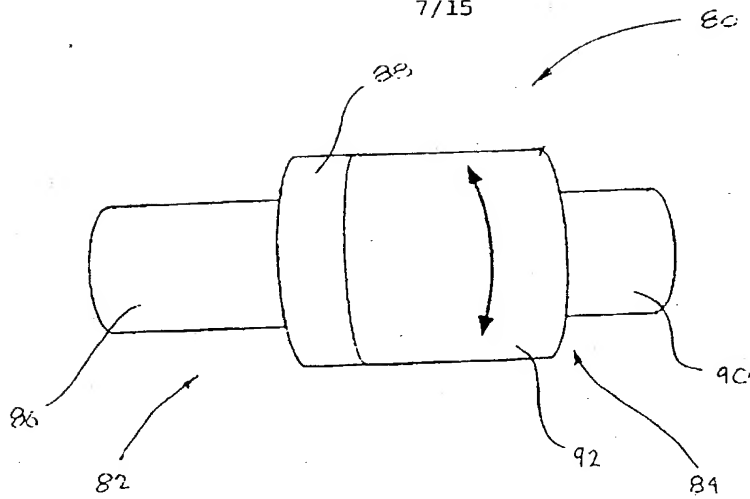


FIG. 7

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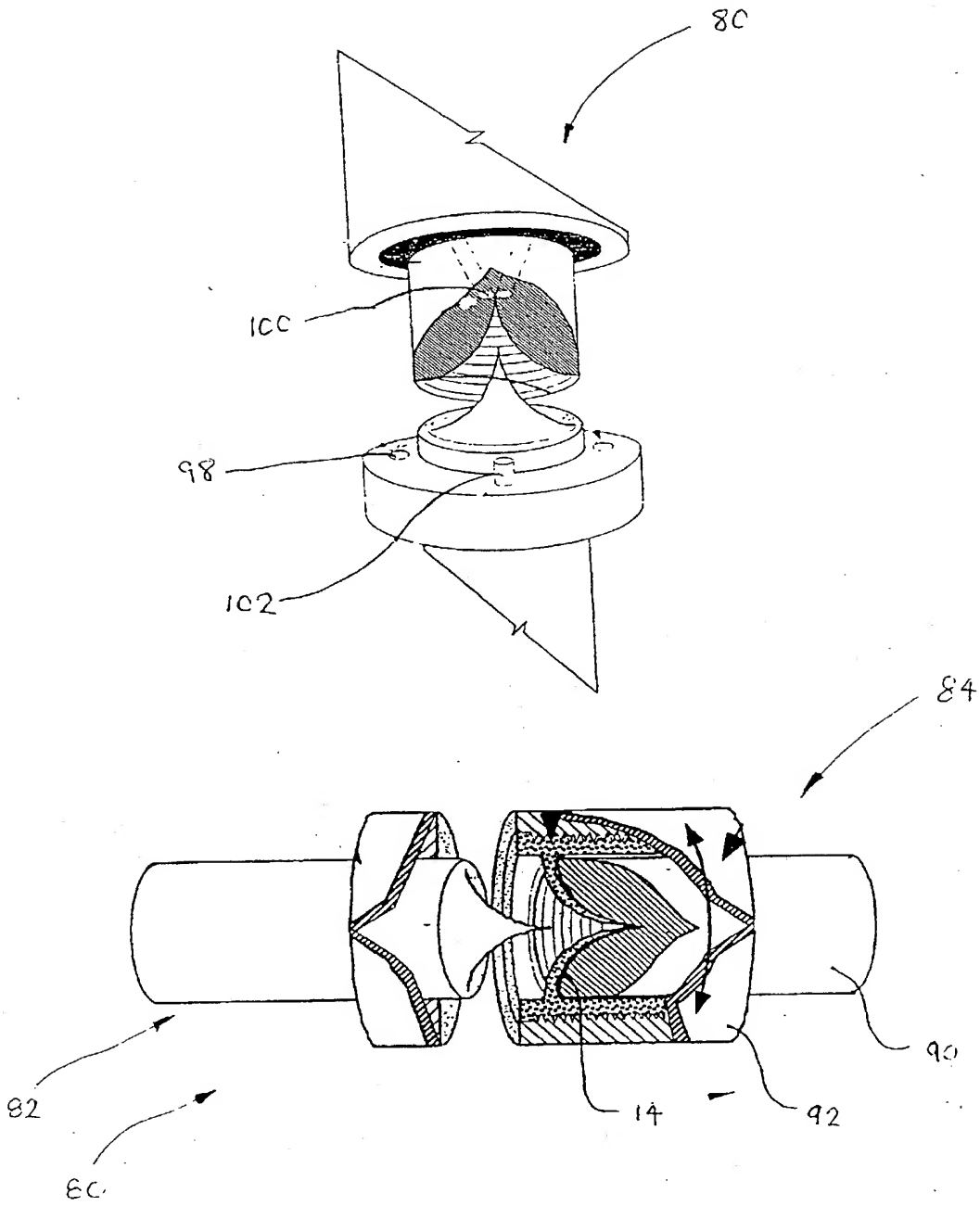


FIG. 8

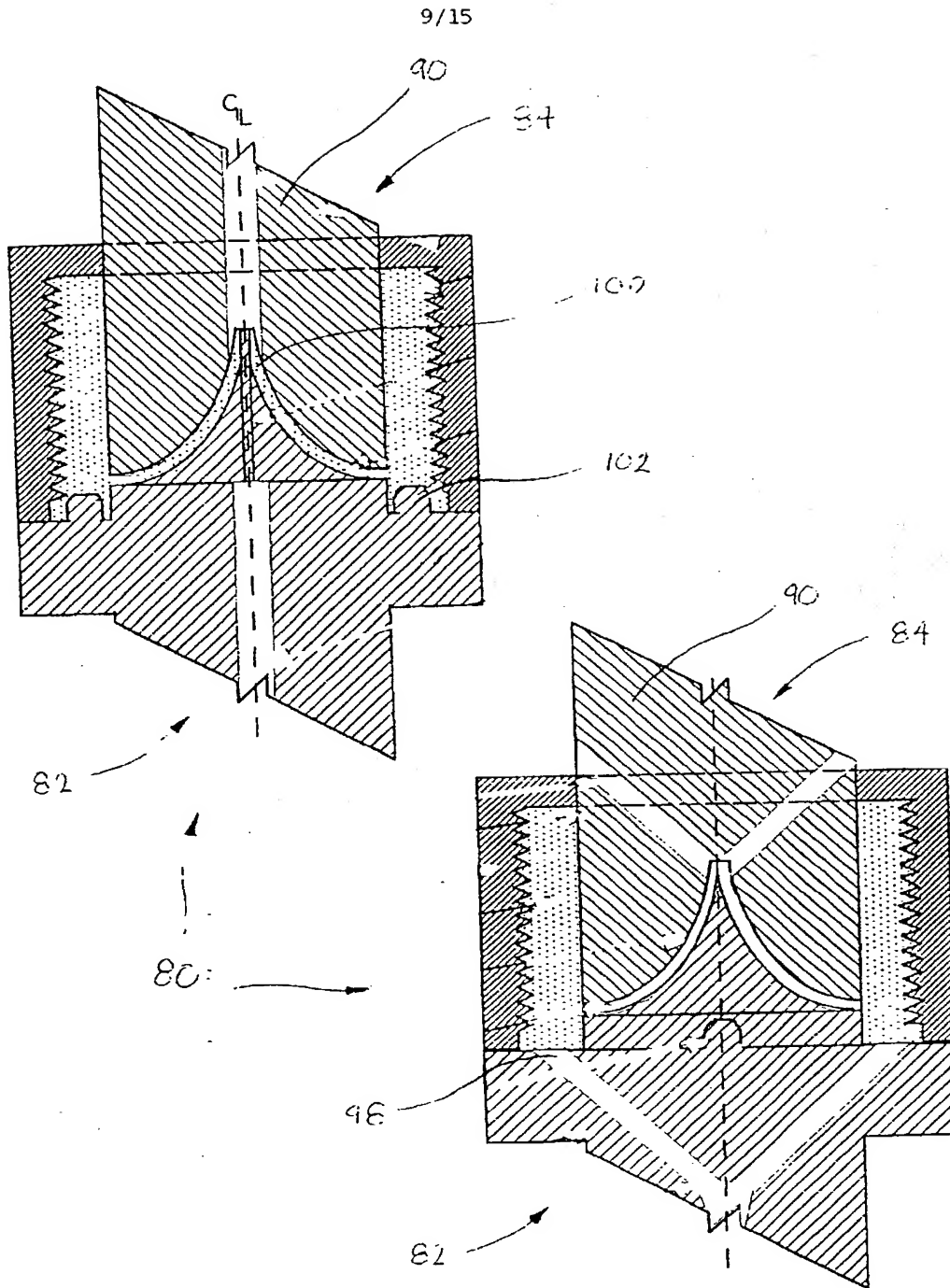


FIG. 9

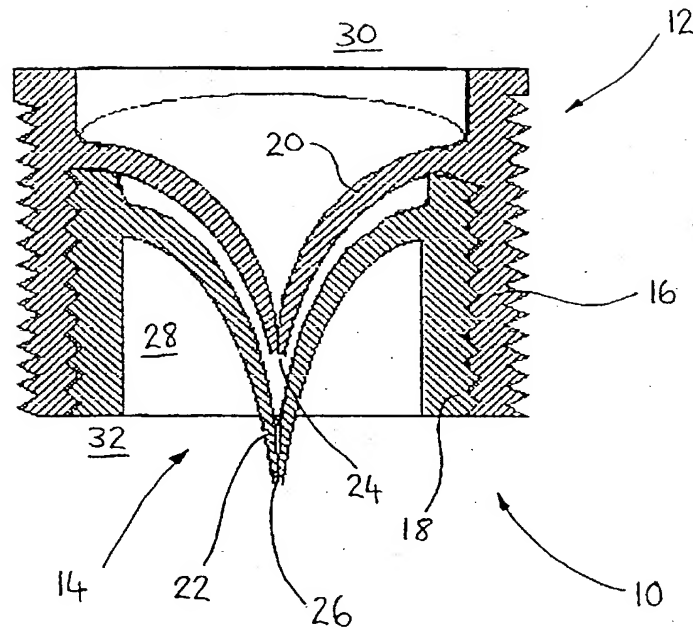


FIG. 10

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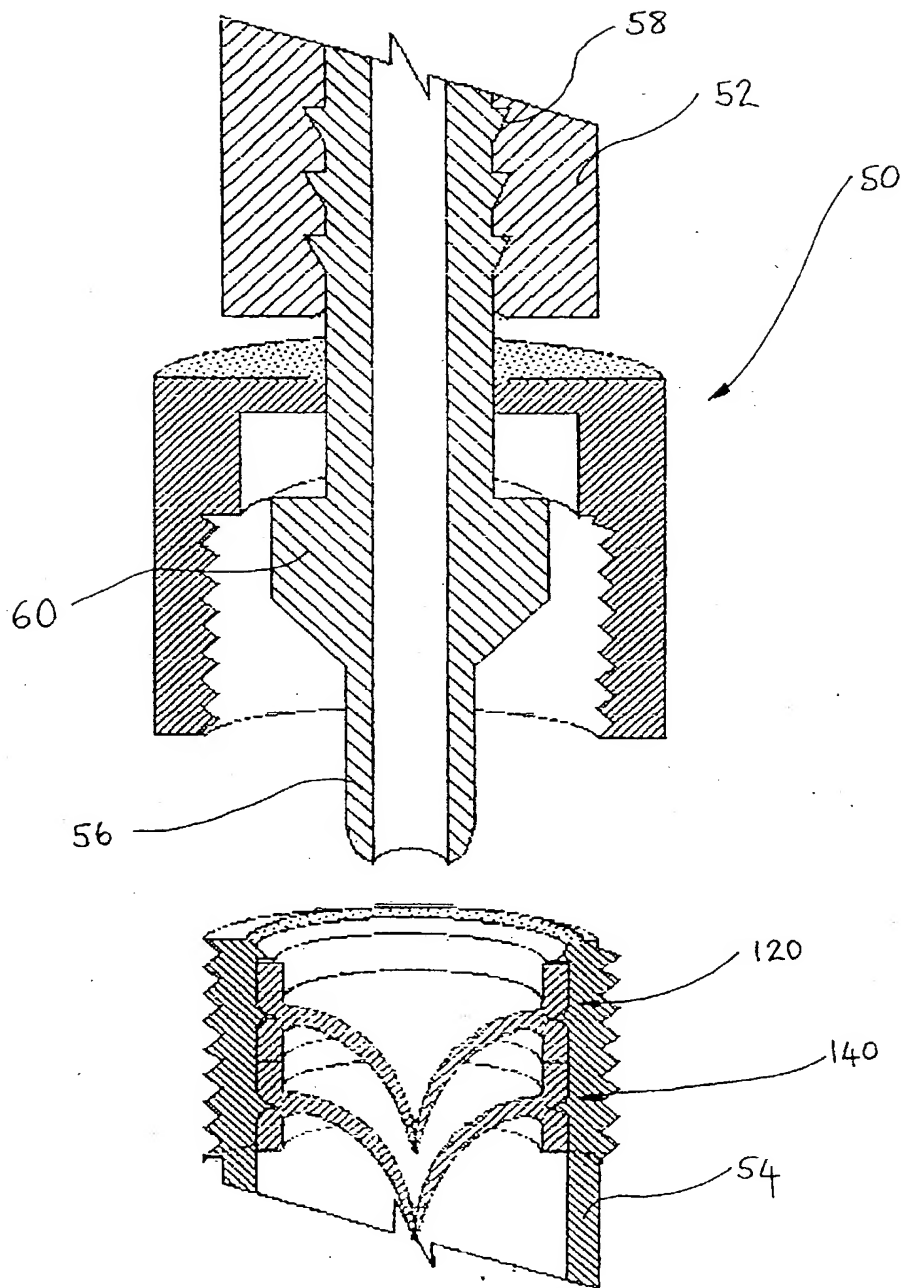


FIG. 11A

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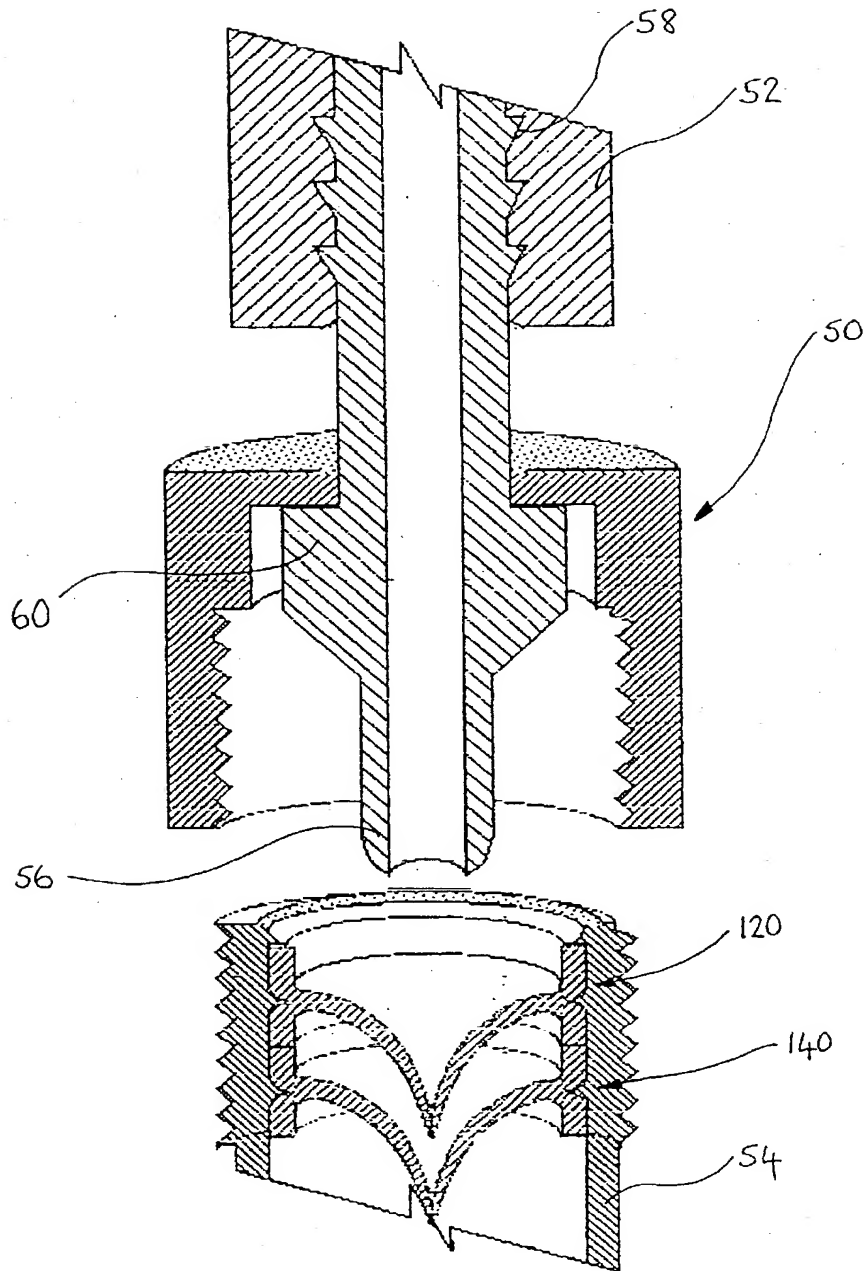


FIG. 11B

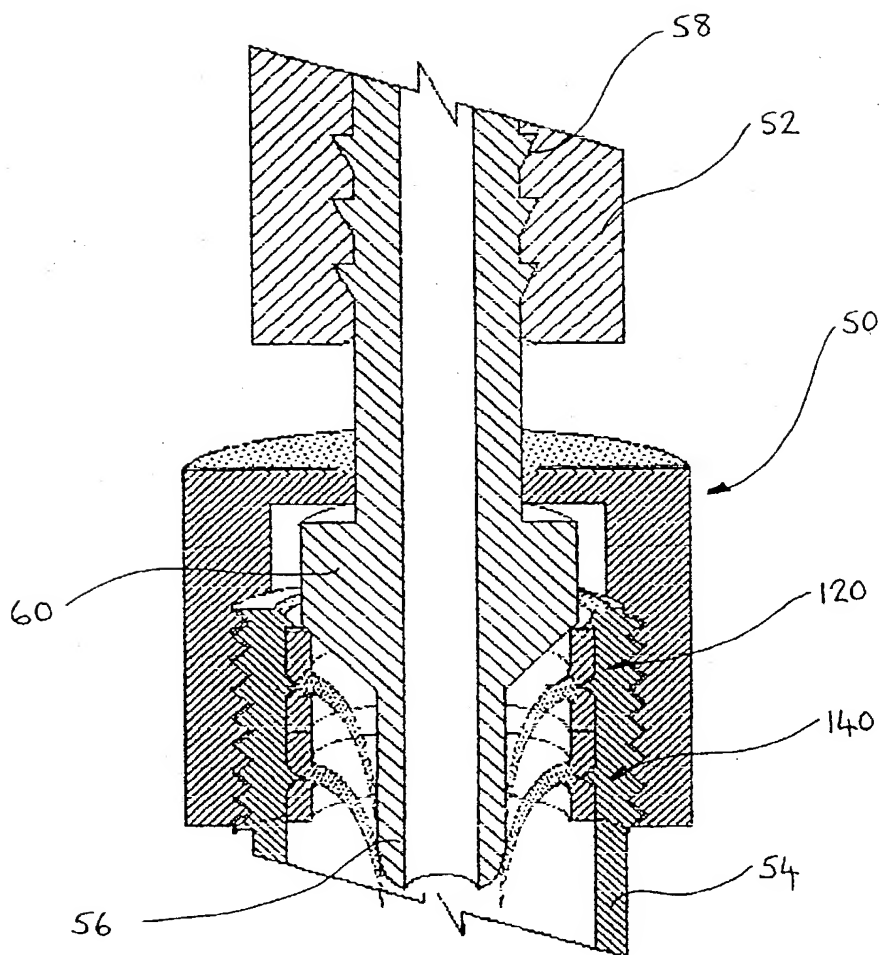


FIG. 11C



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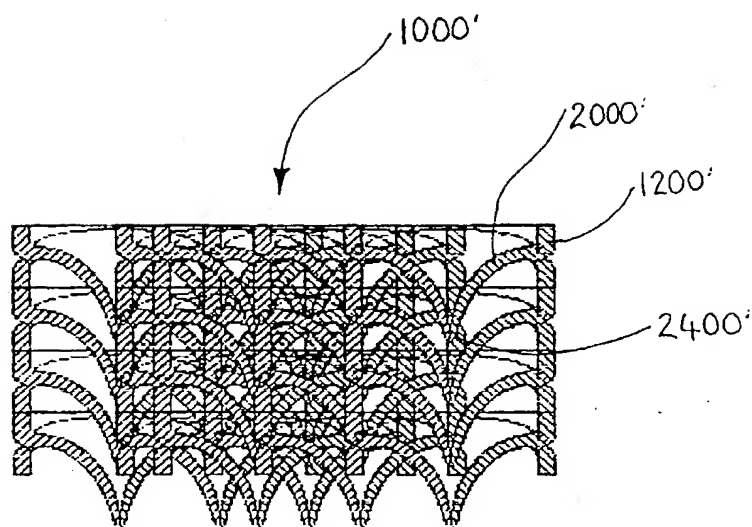


FIG. 13

<b>DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION</b>	Docket No.	P0
	1 <sup>st</sup> Inventor	
	COMPLETE IF KNOWN	
Declaration Submitted with Initial Filing	Serial No.	
Declaration Submitted after Initial Filing	Filing Date	

As a below named inventor, I hereby declare that:

My residence, mailing address and citizenship are as stated below next to my name.

I believe I am the original and first inventor of the subject matter which is claimed and for which a patent is sought on the invention entitled

A NON-RETURN VALVE

the specification of which:

\_\_\_\_\_ is attached hereto

OR

X Was filed on 14 December 2001 as US Application No. 10/018,056

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment specifically referred to above.

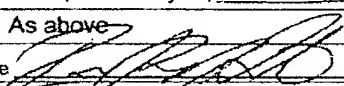
I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56, including for continuation-in-part applications, material information which became available between the filing date of the prior application and the national or PCT international filing date of the continuation-in-part application.

I hereby claim FOREIGN PRIORITY benefits under 35 USC 119(a)-(d) or (f), or 365(b) of any foreign application(s) for patent, inventor's certificate(s), or 365(a) of any PCT international application which designated at least one country other than the US, listed below and have also identified below by checking the box, any foreign application for patent, inventor's certificate(s), or any PCT international application having a filing date before that of the application on which priority is claimed. ( ADDITIONAL APPLICATIONS IDENTIFIED ON ADDITIONAL INFORMATION SHEET )

Prior Foreign Appl. No.	Country	Day/Month/Year Filed	Priority Not Claimed
PQ4713	Australia	15 June 1999	<input checked="" type="checkbox"/>
PQ2387	Australia	23 August 1999	<input checked="" type="checkbox"/>

As a named inventor, I hereby appoint the registered practitioners of **LARSON & TAYLOR, PLC**, associated with Customer Number 000881 to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith. Direct all correspondence to that Customer Number. Direct all telephone calls to \_\_\_\_\_ at TEL (703) 739-4900 (Fax: 703-739-9577) e-mail: \_\_\_\_\_

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 USC 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon. ( ADDITIONAL INVENTORS IDENTIFIED ON ADDITIONAL INFORMATION SHEET )

<b>SOLE OR FIRST INVENTOR</b>		Citizenship	AUSTRALIA
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Full Mailing Address <u>35 Alexandra Street, Drummoyne, New South Wales 2047, AUSTRALIA</u>		Residence - City, State/Country (if different from PO address) <u>As above</u>	
SIGN AND DATE HERE Inventor's Signature 		Date <u>25/02/02</u>	
<b>SECOND JOINT INVENTOR (if any)</b>		Citizenship	
Given Name (First and Middle (if any))		Family Name or Surname	
Full Mailing Address		Residence - City, State/Country (if different from PO address)	
SIGN AND DATE HERE Inventor's Signature		Date	
<b>THIRD JOINT INVENTOR (if any)</b>		Citizenship	
Given Name (First and Middle (if any))		Family Name or Surname	
Full Mailing Address		Residence - City, State/Country (if different from PO address)	
SIGN AND DATE HERE Inventor's Signature		Date	

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